Dr. Leo Esaki, the 1973 Nobel Prize winner in physics, shares his inspiration with ASC attendees. (U.S. Army photo by Richard Mattox, Program Executive Office Enterprise Information Systems (PEO EIS).) Depicted in the inset photo, Dr. Leo Esaki (right) carries one of the first Sony tape recorders to a 1958 European electronics conference. At left is Dr. William B. Shockley, 1956 Nobel Prize winner in physics. (Photo courtesy of Dr. Leo Esaki.)

Wise and Witty — Seven Nobel Laureates Address 25th Army Science Conference (ASC)

Meg Williams

The U.S. Army celebrated its past scientific accomplishments, showcased current experiments and research, and welcomed current and future scientists to the 25th ASC, Nov. 27-30, 2006, in Orlando, FL. It was a rare treat and great honor for the more than 1,600 participants to hear speeches from seven Nobel Laureates who earned their prizes while they worked on Army projects. After they finished speaking, many people in the audience brought their programs to be autographed and had their pictures taken with the great scientific minds of the past 50 years:

- Dr. Charles H. Townes, 1964 Nobel Prize in physics for the invention of the laser and maser.
- Dr. Leon Cooper, 1972 Nobel Prize in physics for his studies on the theory of superconductivity.
- Dr. Leo Esaki, 1973 Nobel Prize in physics for electron tunneling in solids.
- Dr. Leon M. Lederman, 1988 Nobel Prize in physics for the neutrino beam method and discovery of the muon neutrino.
- Dr. Robert F. Curl, 1996 Nobel Prize in chemistry for the discovery of fullerenes.
- Dr. David M. Lee, 1996 Nobel Prize in physics for discovering superfluidity in helium-3.
- Dr. John B. Fenn, 2002 Nobel Prize in chemistry for identification methods and structure analyses of biological macromolecules.

The laureates brought slides and viewgraphs and told the stories of their famous discoveries. It was like having a front-row seat to the seminal science lectures of the past half century — it was sublime. To see the laureates' presentations, go to **www.asc2006.com**. To watch their filmed speeches, go to

the Defense Acquisition University's Web site at **http://view.dau.mil/dauvideo/view/channel.jhtml?stationID=1994197044**.

Dr. John Parmentola, Director of Research and Laboratory Management, Office of the Deputy Assistant Secretary of the Army for Research and Technology, said that the U.S. Army has sponsored and supported 30 Nobel Prize winners over the years. "We find through our experiences and inquiries a profound intelligence in the natural world, which is much greater than our own," Parmentola said. "There are rare moments in human history where the very few have had the fortune and talent to touch this intelligence with their minds, albeit for a brief moment. They are the rare ones who at that rare moment are the first to understand something that no human has understood before."

"Through this process we call research, these remarkable individuals bring certainty to an uncertain world," Parmentola continued, "and, as a result, their profound discoveries lead to further discoveries and numerous innovations to help improve the human condition and give us all hope that we can achieve a better world for all mankind."

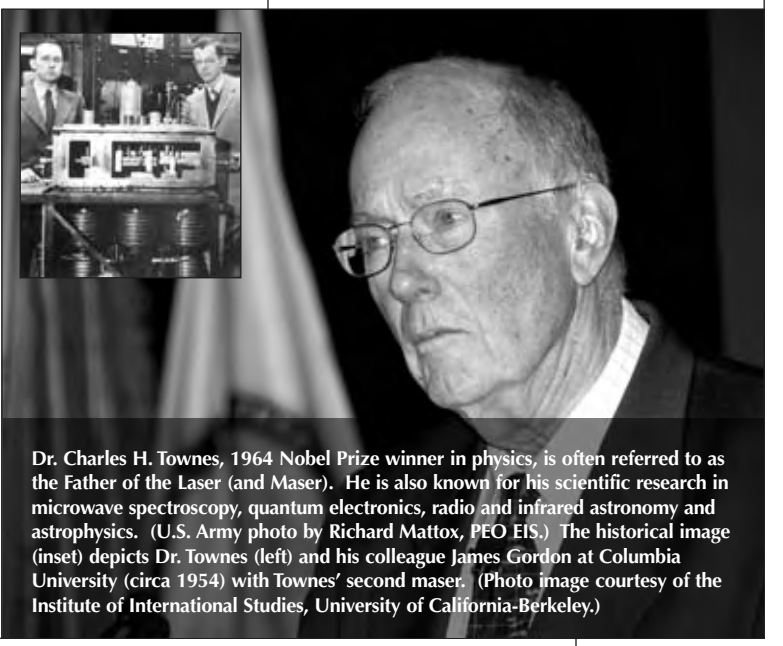
The seven Army-sponsored Nobel laureates spoke of the "creative failures" that propelled them to their winning discoveries. They all also pointed out that such discoveries are never found by only one person, but rather teams of researchers; and they delved into the mindset it takes to press toward a goal. Following are some of their nonscientific stories that the Army Acquisition, Logistics and Technology Workforce can apply to its daily work ethic.

Experts Are Not Always Right

Esaki, one of the participants in the quantum revolution, said his success in discovering the Esaki Tunnel Diode, the first quantum electron device, in 1947 could be credited to his willingness to move to new environments and question authority figures during his younger years. It was very common for Japanese workers to stay with one company for their entire careers. Esaki did not follow that path, moving from a small Japanese company to Sony to the IBM Watson Research Center in the United States. He presented his "Five Don'ts" for anyone interested in realizing his or her creative potential. "Who knows," Esaki said, "it may even help you win a Nobel Prize."

- Don't allow yourself to be trapped by past experiences. If you allow yourself to get caught up in social convention or circumstances, you will not notice the opportunity for a dramatic leap forward when it presents itself. We have a "judicious mind" and a "creative mind." More important is the creative mind. We work from the age of 20 to 70. We use our creative mind until we are 45. The crossing point is 45. Then he turned to the crowd and winked, "If you are older than 45, don't believe my theory."
- Don't allow yourself to be overly attached to any authority in your field or you risk losing sight of yourself.
- Don't hold on to what you don't need. We have easy access to an enormous amount of information. In terms of memory, the human brain has not changed much since ancient times. Constantly input and delete information and only save the truly vital and relevant information.
- Don't avoid confrontation. At times it's necessary to put yourself first and defend your own position. Fighting is sometimes unavoidable for the sake of self-defense.
- Don't forget your spirit of childhood curiosity. It is a vital component for imagination.

Esaki displayed his playful spirit when he showed a photograph of himself and another Nobel Laureate, Dr. William B. Shockley, taken at a 1958 European electronics conference (Page 76). Working for Sony at the time, Esaki took the latest Sony development, a tape recorder — a very large device in its first incarnation. The first stop before arriving in Europe was New Delhi, and he demonstrated the recorder for the customs officers. "It was the first time they had seen such a thing and they wanted to buy it," Esaki recounted. "Someone asked if it recorded English. 'No,' I told him, 'it's still in development stage and it records only Japanese.'"



Dr. Charles H. Townes, 1964 Nobel Prize winner in physics, is often referred to as the Father of the Laser (and Maser). He is also known for his scientific research in microwave spectroscopy, quantum electronics, radio and infrared astronomy and astrophysics. (U.S. Army photo by Richard Mattox, PEO EIS.) The historical image (inset) depicts Dr. Townes (left) and his colleague James Gordon at Columbia University (circa 1954) with Townes' second maser. (Photo image courtesy of the Institute of International Studies, University of California-Berkeley.)

Dr. David M. Lee, 1996 Nobel Prize winner in physics for his collaborative work on low-temperature helium-3, was one of the ASC's distinguished presenters. (U.S. Army photo by Richard Mattox, PEO EIS.)

Keep an Open Mind

Townes, the inventor of the laser, echoed Esaki's advice to stay true to your own ideas. "We have to be willing to differ with senior people in our field," he advised. "We have to be willing to differ with the majority. We have to be willing to explore new ideas. I had convinced myself that the maser had to work. I had the idea in 1951 and we first got it working in 1954."

As they outlined how they had come to their important discoveries, many of the seven Nobel Laureates emphasized how important it is to have interactions between different scientific and engineering fields, people, industries and universities. "It is important for us to be open-minded and explore those things that we don't know are going to pay off," Townes continued. "Once I had the idea for the laser, I could see applications for communications, precise measurements, cutting and burning. But I never dreamed the laser would be useful to medicine. I'm emotionally very moved when someone tells me that laser surgery saved their eye or reattached their retina. I never dreamed that would happen."

Lee, who devoted his career to low-temperature physics, noted that he was influenced by the work of biology researchers: "I like to think of science as a worldwide web — everybody helping everybody else," Lee said. "We compete — but we also pull each other up by our collective bootstraps. One of the most exciting things about our business is that we have these interactions that are so meaningful."

Don't Lose Your Sense of Humor

Not only did these men unravel mysteries of the natural world, but they also could throw down a one-liner. Take Lederman, the Rodney Dangerfield of theoretical physicists. After

Dr. Leon M. Lederman, 1988 Nobel Prize winner in physics for his work on neutrinos, is also credited with helping the Army develop Doppler radar. (U.S. Army photo by Richard Mattox, PEO EIS.)

Parmentola recounted Lederman's many accomplishments during his introduction, Lederman quipped, "I like introductions like that. Sometimes there is a negative aspect to fame and recognition. I was on a crowded train coming out of Chicago when it stopped at the local mental hospital. A nurse and a bunch of patients were going on an outing and they all scrambled onto the train. The nurse was making sure everyone was there and was doing a head count, 'One, two, three, four,' then she looked at me and said, 'Who are you?' I said I was Leon Lederman, Nobel Prize winner. She said, 'Yeah right, five, six…'"

Lederman spent 3 years in the Army Signal Corps during World War II. While in the military, Lederman helped develop Doppler radar. "And it was to my chagrin many years later that I got a speeding ticket from a police officer using Doppler radar," he said. "And the police officer was using it all wrong. Any kid knows that the Doppler radar direction has to be roughly parallel to your speed. It doesn't have to be exactly parallel, but if it is 90 degrees away, you have no velocity component, and the policeman had no velocity component. I explained that clearly to the judge — who nevertheless asked me to pay my fine. After that, I decided that all judges should have a 5th grade physics education."

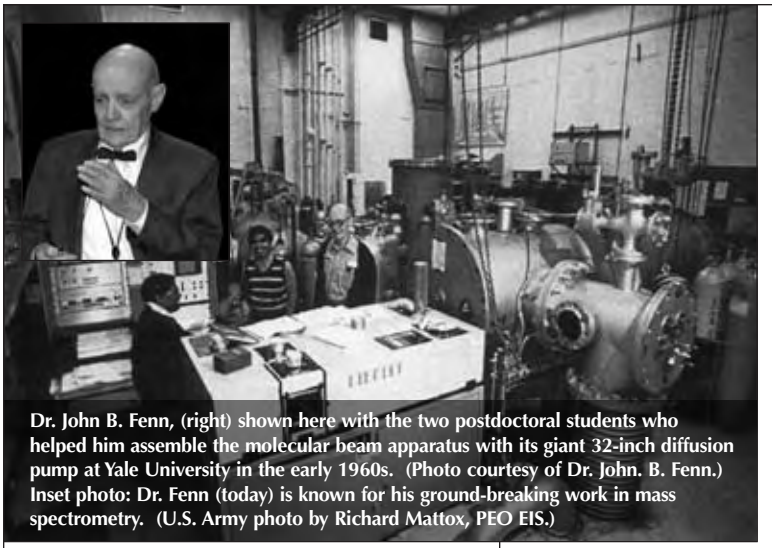
Tell Your Wife That Diamonds Are Not Forever

"Carbon is really remarkable in the variety of manifestations that it has," said the man who discovered the buckminsterfullerene, Curl. "Graphite is used in pencils and as a lubricant; while the diamond, of course, is ornamental and is also used in cutting and as a coating material. Graphite is the most stable, diamond is not as stable as graphite, so diamonds are not actually forever, but it takes longer than most people care about for a transformation to take place."

Dr. Robert F. Curl, 1996 Nobel Prize winner in chemistry, discovered the buckminsterfullerene, also known as "Bucky Balls," a stable molecule made of pure carbon. (U.S. Army photo by Richard Mattox, PEO EIS.)

Age 85 Is the New 45

No doubt Fenn would disagree with Esaki's assertion that our judicious mind takes over at age 45. Fenn joined Yale University faculty in 1962. In 1987, when he reached the mandatory retirement age, he fought age



Dr. John B. Fenn, (right) shown here with the two postdoctoral students who helped him assemble the molecular beam apparatus with its giant 32-inch diffusion pump at Yale University in the early 1960s. (Photo courtesy of Dr. John. B. Fenn.) Inset photo: Dr. Fenn (today) is known for his ground-breaking work in mass spectrometry. (U.S. Army photo by Richard Mattox, PEO EIS.)

discrimination and a university-mandated move to a smaller laboratory space. He remained at Yale and was 70 years old when he began work on what would become his Nobel Prize-winning discovery. When Fenn won the Nobel Prize in 2002 for his work in mass spectrometry, he was 85.

Fenn studied combustion and set about to study chemical reactions in flames the same way physicists studied nuclear reactions. In other words, bang two molecules together and make them react.

"To do that," Fenn explained, "we needed to somehow get a lot of kinetic energy and high velocity into fuel molecules and oxygen molecules. I decided we wanted to build a molecular beam apparatus with a lot of pumping speed and see if we could get a collision between two different reactants. Now, this was a very naïve idea. I sent a proposal for this idea to the National Science Foundation and they funded us. When one of my postdoctorate students got one look at a couple of 32-inch diffusion pumps — nothing would do until we could get those pumps. I was scared to death, but it turned out to be the smartest thing we ever did because having a lot of pumping speed meant that we could cover up a lot of errors. Furthermore, once we started getting results and people came to the lab, they took one look at the apparatus and said, 'Very nice, but not for us.' So we had the field to ourselves for a very long time."

Continue to Invest in Research

"I think it's just wonderful how much the Armed Services have contributed to basic science and exploration," Townes told the ASC audience. "Unfortunately, our industry no longer does that. Industry just can't put money into exploration that may not pay off for another 10 years. However, as a country we must, and as a people, we must. Just look at the laser. It cost $30,000 to produce the first laser and the payoff every year is probably tens of billions of dollars. It's been said that all of the research done is less than one week's worth of investments in applications. Science pays off. We've got to remember that and devote our energies and our finances to doing it."

Dr. Leon Cooper, 1972 Nobel Prize winner in physics, emphasized the importance of balancing present operational needs against investments for future scientific discoveries. (U.S. Army photo by Richard Mattox, PEO EIS.)

Cooper seconded Townes. "It is the unexpected dividend of profound fundamental research that gives us payoffs in totally unexpected directions," he said. "Consider the technology we take for granted for civilian and military use — things like communications, computers, electronics, medical imaging and laser surgery would not have existed without the fundamental science of Maxwell, Einstein, Lorentz, Kamerlingh Onnes, Schrodinger, Heisenberg, Dirac and many others working on problems that were so esoteric that no practical person would have funded them. It's almost impossible to predict what technologies will flow from fundamental science. From the work of Charlie Townes, who was studying radiology, we have laser surgery and compact discs."

"At a time when funding is limited," Cooper continued, "those of you who are responsible for dispensing funds find it difficult to think of the future with all the current needs that have to be satisfied. This troubles me. It's just a way of saying you're eating your seed corn. You have to balance the immense needs of the present against the needs of the future. I would like to think that when you celebrate the 50th anniversary of the ASC, you will find people like myself who can proudly say that our work was supported by the Army Research Office. It's not an easy job and I wish you good luck."

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